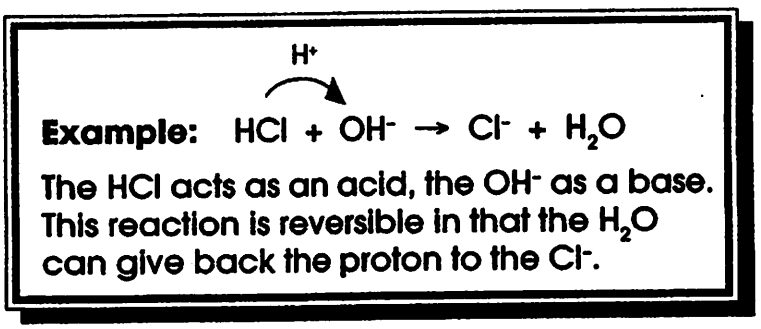
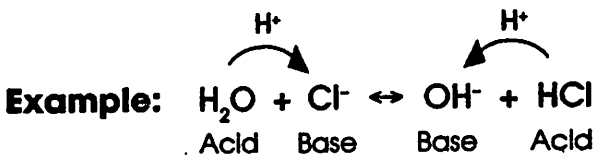
BRONSTED-LOWRY ACIDS AND BASES

Name _____

According to Bronsted-Lowry theory, an acid is a proton (H^+) donor, and a base is a proto acceptor.



Label the Bronsted-Lowry acids and bases in the following reactions and show the direction of proton transfer.



1. $H_2O + H_2O \leftrightarrow H_3O^+ + OH^-$

2. $H_2SO_4 + OH^- \leftrightarrow HSO_4^- + H_2O$

3. $HSO_4^- + H_2O \leftrightarrow SO_4^{-2} + H_3O^+$

4. $OH^- + H_3O^+ \leftrightarrow H_2O + H_2O$

5. $NH_3 + H_2O \leftrightarrow NH_4^+ + OH^-$

CONJUGATE ACID-BASE PAIRS

Name _____

In the exercise, Bronsted-Lowry Acids and Bases, it was shown that after an acid has given up its proton, it is capable of getting back that proton and acting as a base. Conjugate base is what is left after an acid gives up a proton. The stronger the acid, the weaker the conjugate base. The weaker the acid, the stronger the conjugate base.

Fill in the blanks in the table below.

Conjugate Pairs

	ACID	BASE	EQUATION
1.	H_2SO_4	HSO_4^-	$H_2SO_4 \leftrightarrow H^+ + HSO_4^-$
2.	H_3PO_4		
3.		F^-	
4.		NO_3^-	
5.	$H_2PO_4^-$		
6.	H_2O		
7.		SO_4^{-2}	
8.	HPO_4^{-2}		
9.	NH_4^+		
10.		H_2O	

Which is a stronger base, HSO_4^- or $H_2PO_4^-$? _____

Which is a weaker base, Cl^- or NO_2^-? _____

Predict the products and balance the following equations.

1. $Zn + H_2SO_4 \rightarrow$
2. $MgO + HCl \rightarrow$
3. $Al_2O_3 + H_3PO_4 \rightarrow$
4. $MgCO_3 + H_2SO_3 \rightarrow$
5. $NaOH + HClO \rightarrow$
6. $MgO + H_2O \rightarrow$
7. $CO_2 + NaOH \rightarrow$
8. $H_2SO4 + NH_4OH \rightarrow$

Write the complete, ionic, and net ionic equation for the neutralization reaction between nitrous acid and lithium hydroxide.

For the following incomplete reaction:

$Zn + HCl \rightarrow$

How many grams of zinc chloride would be produced if 100. mL of 2.3 M HCl reacted with an excess of zinc?

Predict the products and balance the following equations.

1. $Zn + H_2SO_4 \rightarrow$

2. $MgO + HCl \rightarrow$

3. $Al_2O_3 + H_3PO_4 \rightarrow$

4. $MgCO_3 + H_2SO_3 \rightarrow$

5. $NaOH + HClO \rightarrow$

6. $MgO + H_2O \rightarrow$

7. $CO_2 + NaOH \rightarrow$

2nd Choice:

8. $H_2SO_4 + NH_4OH \rightarrow$

9. $SO_2 + H_2O \rightarrow$

10. $NO_2 + H_2O \rightarrow$

11. $Na_2O + H_2O \rightarrow$

12. $CaO + CO_2 \rightarrow$

Write the complete, ionic, and net ionic equation for the neutralization reaction between nitrous acid and lithium hydroxide.

For the following incomplete reaction:

$Zn + HCl \rightarrow$

What would the concentration of zinc chloride be produced if 100. mL of 2.3 M HCl reacted with an excess of zinc? (Assume no change in amount of liquid)

pH AND pOH

Name _____

The pH of a solution indicates how acidic or basic that solution is.

pH range of 0 - 7 acidic
7 neutral
7-14 basic

Since $[H^+]\,[OH^-] = 10^{-14}$ at 25° C, if $[H^+]$ is known, the $[OH^-]$ can be calculated and vice versa.

$pH = -\log [H^+]$ So if $[H^+] = 10^{-6}$ M, pH = 6.
$pOH = -\log [OH^-]$ So if $[OH^-] = 10^{-8}$ M, pOH = 8.
Together, pH + pOH = 14.

Complete the following chart.

	$[H^+]$	pH	$[OH^-]$	pOH	Acidic or Basic
1.	10^{-5} M	5	10^{-9} M	9	Acidic
2.		7			
3.			10^{-4} M		
4.	10^{-2} M				
5.				11	
6.		12			
7.			10^{-5} M		
8.	10^{-11} M				
9.				13	
10.		6			

pH AND pOH CONTINUED

Name _____

Calculate the pH of the solutions below.

1. 0.01 M HCl

2. 0.0010 M NaOH

3. 0.050 M $Ca(OH)_2$

4. 0.030 M HBr

5. O.150 M KOH

6. 2.0 M $HC_2H_3O_2$ (Assume 5.0% dissociation.)

7. 3.0 M HF (Assume 10.0% dissociation.)

8. 0.50 M HNO_3

9. 2.50 M NH_4OH (Assume 5.00% dissociation.)

10. 5.0 M HNO_2 (Assume 1.0% dissociation.)

ACID-BASE TITRATION

Name _____

To determine the concentration of an acid (or base), we can react it with a base (or acic of known concentration until it is completely neutralized.. This point of exact neutralizatior known as the endpoint, is noted by the change in color of the indicator.

We use the following equation:

$N_A \times V_A = N_B \times V_B$ where N = normality, V = volume

Solve the problems below.

1. A 25.0 mL sample of HCl was titrated to the endpoint with 15.0 mL of 2.0 N NaOH. What was the normality of the HCl? What was its molarity?

_____

_____

2. A 10.0 mL sample of H_2SO_4 was exactly neutralized by 13.5 mL of 1.0 M KOH. What is the molarity of the H_2SO_4? What is the normality?

_____

_____

3. How much 1.5 M NaOH is necessary to exactly neutralize 20.0 mL of 2.5 M H_3PO_4?

_____

4. How much of 0.5 M HNO_3 is necessary to titrate 25.0 mL of 0.05 M $Ca(OH)_2$ solution to the endpoint?

_____

5. What is the molarity of a NaOH solution if 15.0 mL is exactly neutralized by 7.5 mL of a 0.02 M $HC_2H_3O_2$ solution?

_____

Titration

1. How many millilitres of 0.100 M HCl are required to neutralize 25.0 mL of 0.100 M $Ba(OH)_2$?

2. What is the molarity of a hydrochloric acid solution, 30.0 mL of which is just neutralized by 48.0 mL of 0.100 M NaOH?

3. Exactly 50.0 mL of HClO solution of unknown concentration was titrated with 0.100 mol NaOH. An end point was reached when 38.5 mL of the base was added. Calculate the molar concentration of the HClO solution.

4. Calculate the pH of the resulting solution after 20.00 mL of 0.20 M NaOH has been added to 25.00 mL of 0.20 M HCl.

5. 100.00 mL of 0.100 M potassium hydroxide is titrated with 0.200 M nitric acid. Calculate the volume of nitric acid required to reach the equivalence point.

pH and Titrations (H)

1. What is the pH of a 0.00010M NaOH solution? What is the pH of a 0.00050M NaOH solution?

2. A solution is prepared using 15.0 mL of 1.00 M HCl and 20.0 mL of 0.500 M HNO_3. The final volume of the solution is 1.25 L. What are the [H+] and [OH^-] in the final solution? What is the pH of the final solution?

3. A solution of barium hydroxide is to be made that is pH 11.2. How much barium hydroxide will be needed to make 250. mL?

4. A 15.00 mL sample of acetic acid is titrated with 34.13 mL of 0.9940 M NaOH. Determine the molarity of the acid?

5. A H_2SO_4 solution of unknown molarity is titrated with a 1.209 M NaOH solution. The titration requires 42.27 mL of the NaOH solution to reach the equivalence point with 25.00 mL of the H_2SO_4 solution. What is the molarity of the acid solution?

6. A flask contains 41.04 mL of a solution of potassium hydroxide. The solution is titrated and reaches an equivalence point when 21.65 mL of a 0.06151 M HCl solution is added. Calculate the initial pH of the basic solution.